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Title: GCD: Current Performance / Issues

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Intended for: LANL purchased a man instrument (pulse dilation PMT) from the Sydor Instruments, Inc. The company requests to get experimental data obtained using the instrument, for their record.

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GCD: Current Performance / Issues

Gas Cherenkov Detector (GCD) at NIF

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Los Alamos NATIONAL LABORATORY EST. 1943

NNSA National Nuclear Security Administration

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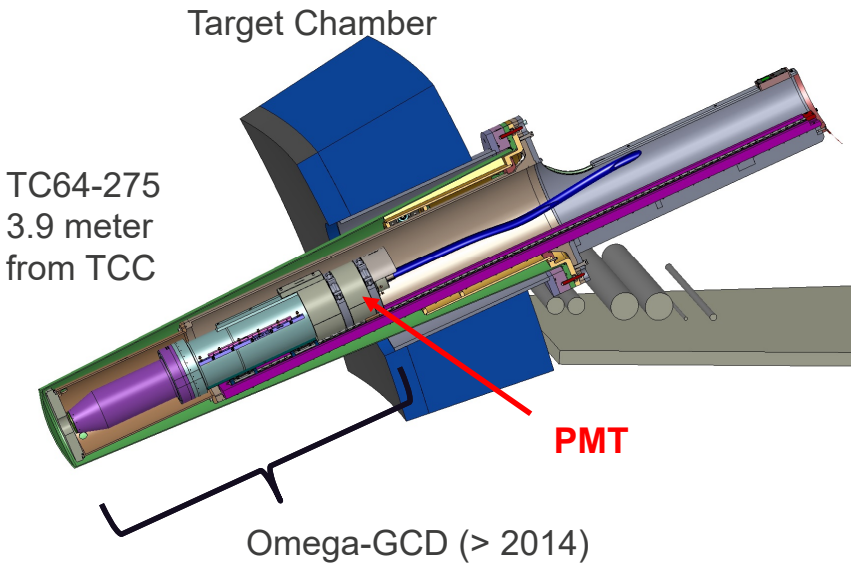
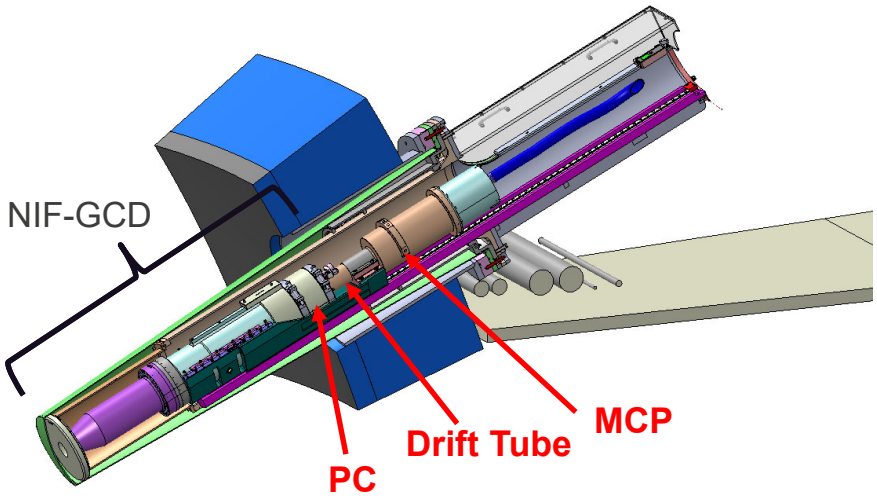
NIF GCD aims to improve time resolution (10 ps) using a Pulse Dilation Photomultiplier (PD-PMT)

Phase I: Omega-GCD with PMT



- N161205 (OQ)
- 100 ps
- > 1E+14

Phase II: NIF-GCD with PD-PMT



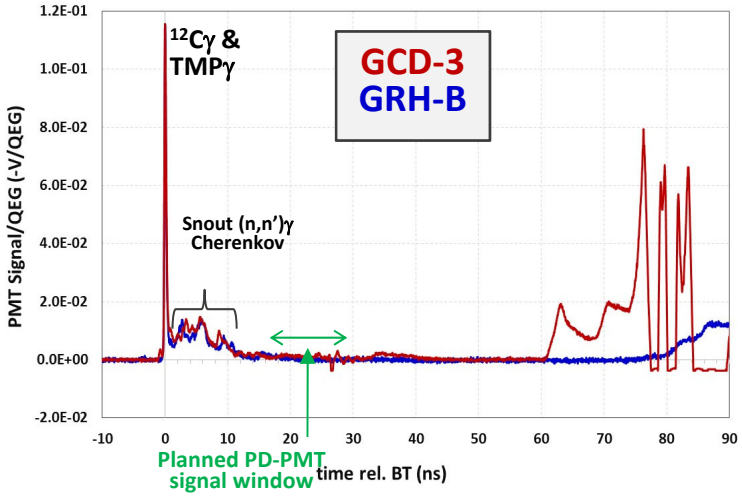
- N180930 (PDPMT OQ)
- N191105 (NIF-GCD OQ)
- 10 ps
- > 1E+15

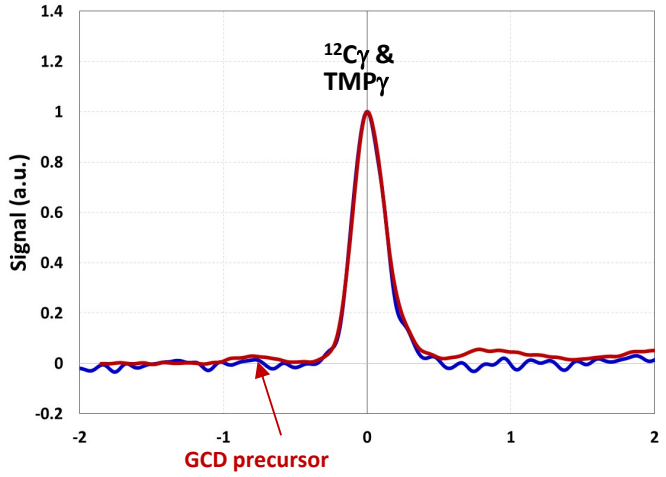
GCD
+
PMT

Stitched & Scaled Data
100 ns window

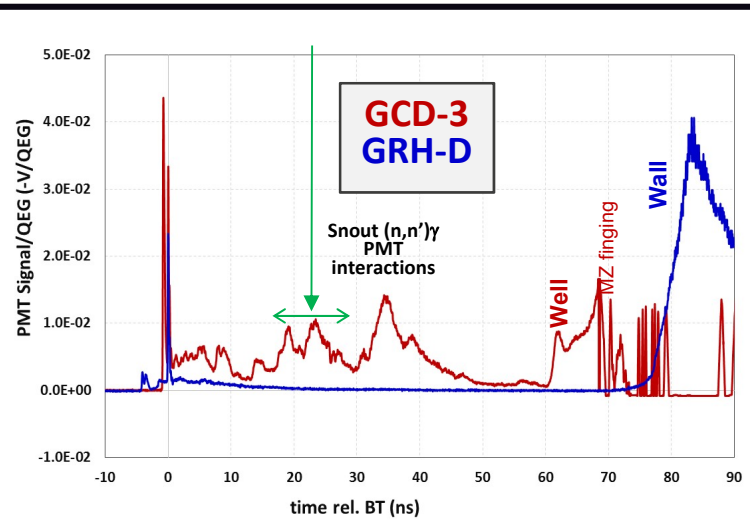
Deconvolved Data
4 ns window

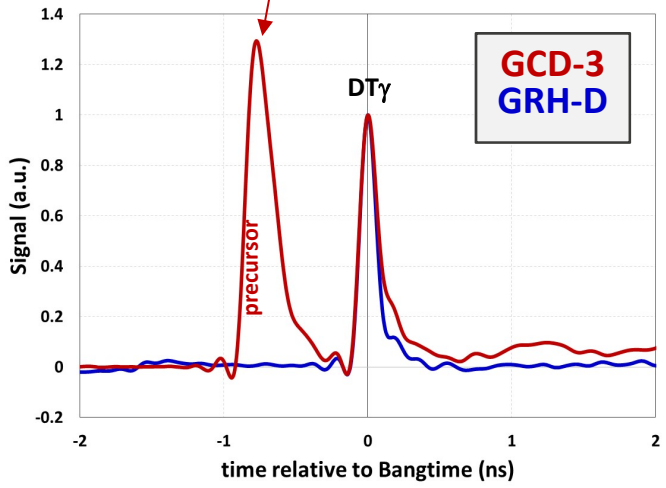
$^{12}C\gamma$ N161205 @ 2.9 MeV





DT γ N170226 @ 8 MeV





PD-PMT for GCD responses to Optical Light

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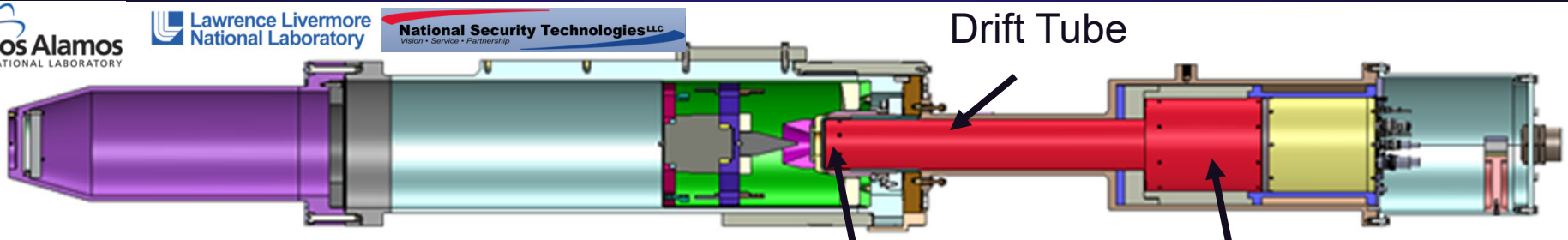

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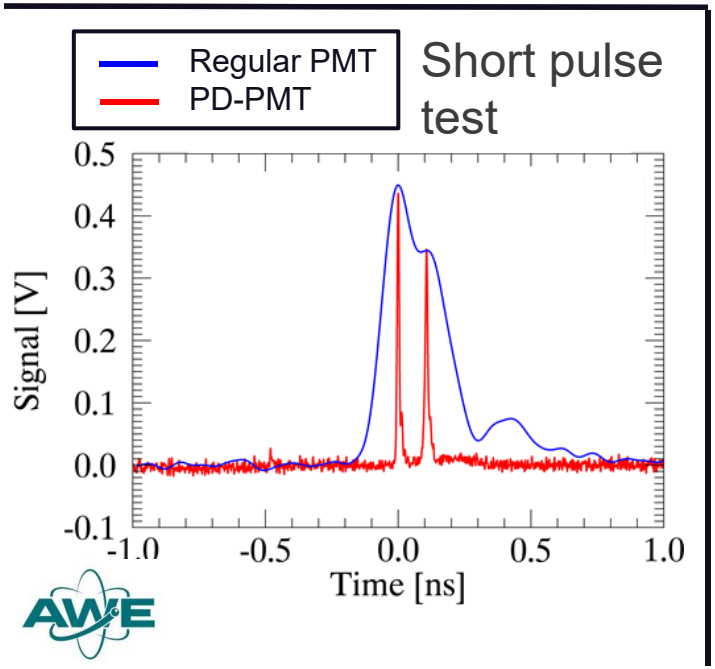
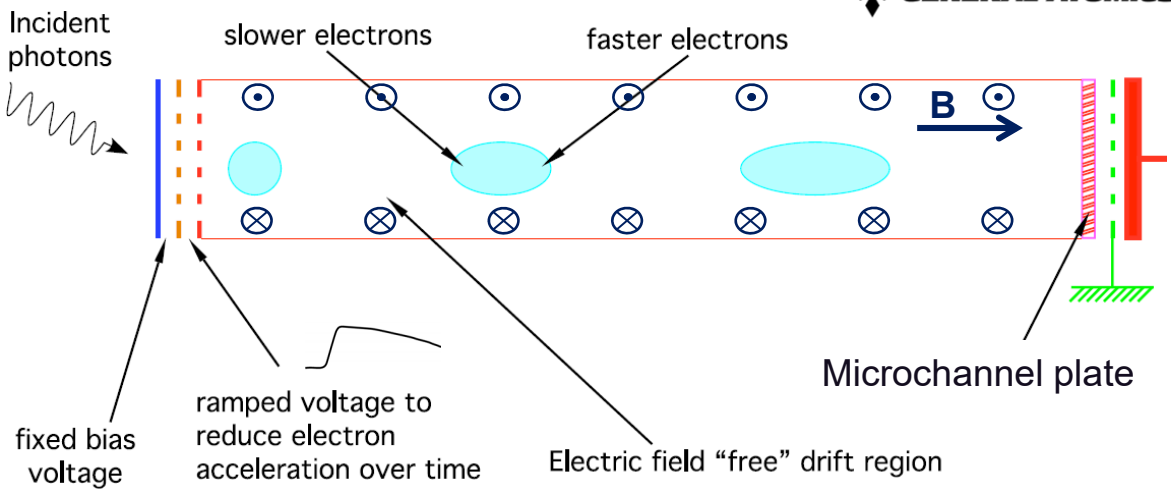
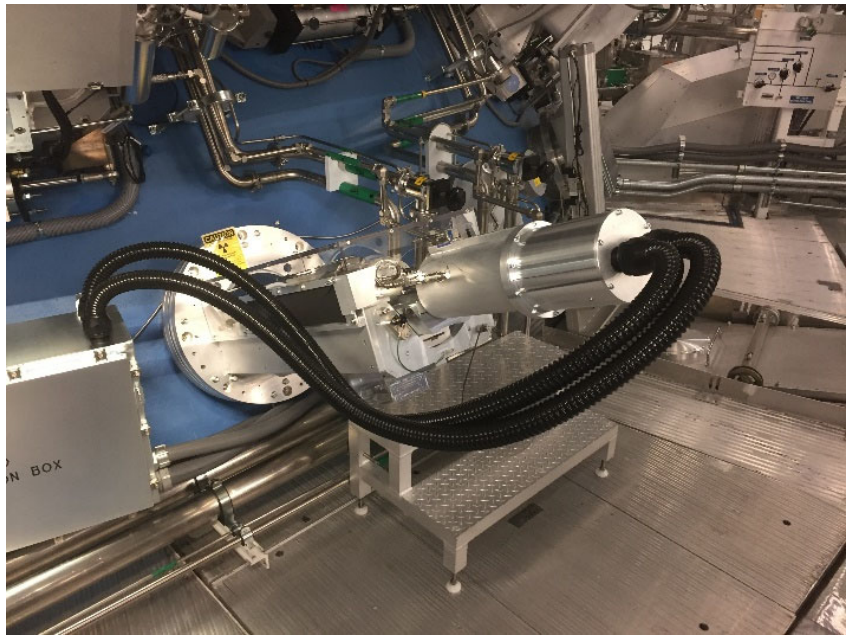


AWE

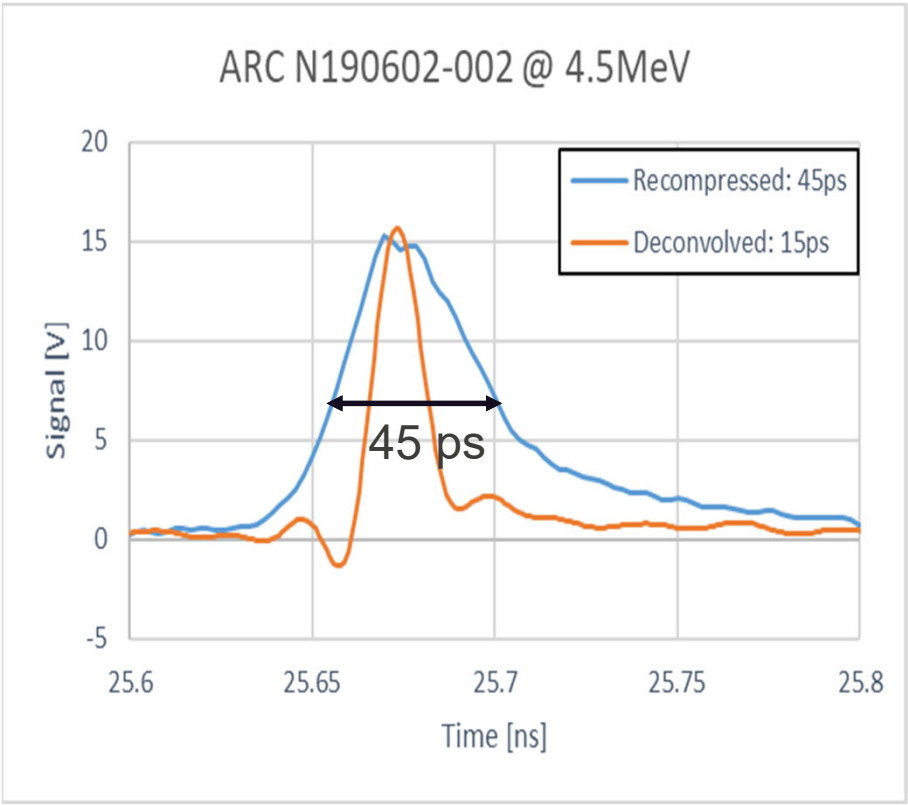


GCD/PD-PMT resolved < 100 ps gamma-signal during ARC shot

PD-PMT installed on the back end of the Gas Cherenkov Detector on the NIF (Aug 2018)



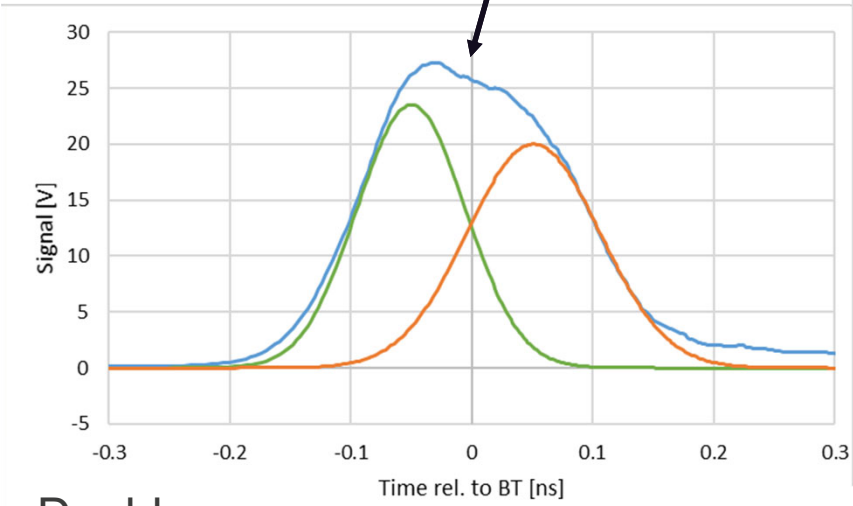
< 100 ps during ARC shot



GCD/PD-PMT reveals structure in reaction history not seen in sister instrument GRH

@ 2.9 MeV mode

Feature visible in PD-PMT data but not in GRH

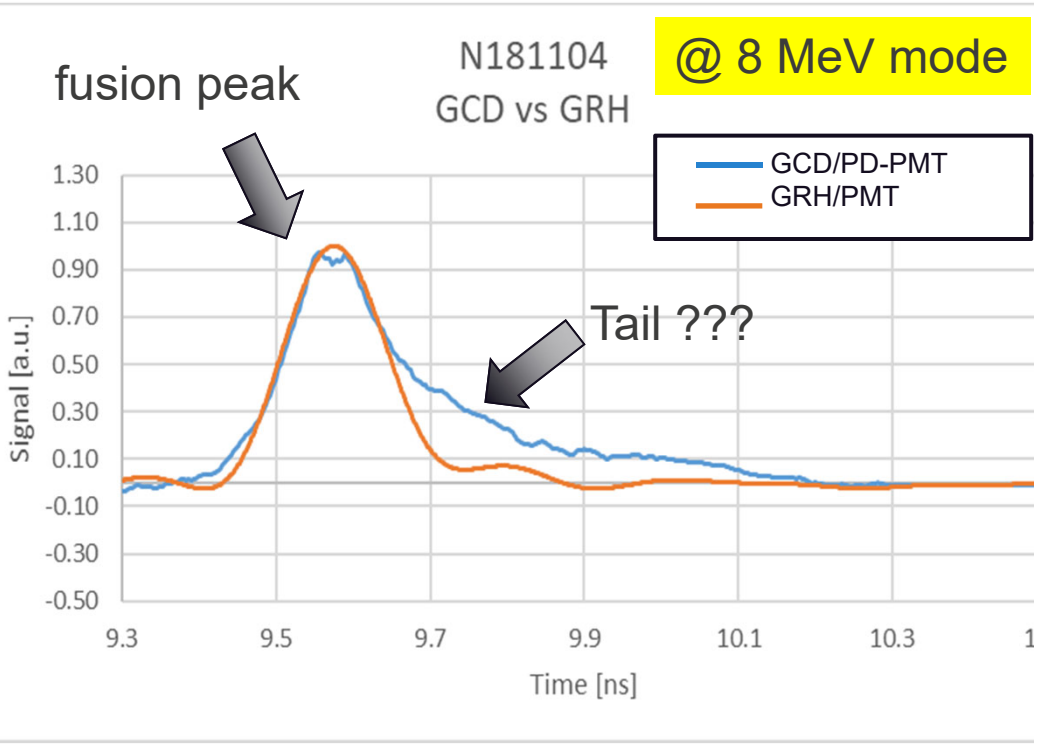


Double Gaussian Decomposition

$^{12}C\gamma$ Signal

Hohlraum /TMP-γ Signal

@ 8 MeV mode



The newly installed GCD/PD-PMT confirms the burn width (FWHM) of existing GRH/PMT agree with GCD/PD-PMT

Issues: is the Tail real (part of fusion signal) or not. If not, where it comes from?

	Hypothesis	Response	Evidences
1	Tail is real (part of fusion signal)	No	- Tail does not scale with Cherenkov threshold - GCD data does not agree with GRH
2	Precursor is causing the tail	No	- Background shot (w/o gas)
3	PD-PMT is causing the tail	No	- 5 GHz optical light calibration
4	8 MeV threshold is not high enough or n-γ causes the tail	No	- 10 MeV test
5	Impurity in CO2 gas is causing the tail	No	- Adding N2 gas
6	CO2 excitation/de-excitation is causing the tail	Probably Yes (lower energy n-γ can still excite gas)	On-going work - W-filter test - Optical blue light filter - Better shielding test